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CALCULUS.

178. Proposed by SAUL EPSTEEN, Ph. D., The University of Chicago.

Evaluate $\int_0^{\frac{1}{2}\pi}\frac{d\phi}{1+\sin^2\phi}$.

I. Solution by G. B. M. ZERR, A. M., Ph. D., Parsons, W. Va.

$$\int_0^{\frac{1}{2}\pi}\frac{d\varphi}{1+\sin^2\varphi}=\int_0^{\frac{1}{2}\pi}\frac{d\varphi}{\sin^2\varphi+\cos^2\varphi+\sin^2\varphi}=\int_0^{\frac{1}{2}\pi}\frac{d\varphi}{\cos^2\varphi+2\sin^2\varphi}$$

$$=\int_0^{\frac{1}{2}\pi}\frac{\sec^2\varphi d\varphi}{1+2\tan^2\varphi}=\frac{1}{\sqrt{2}}\tan^{-1}\left(\sqrt{2}\tan\varphi\right)_0^{\frac{1}{2}\pi}=\frac{\pi}{2\sqrt{2}}.$$

II. Solution by A. H. HOLMES, Brunswick, Me.

Putting $\sin\phi=\tan\theta$, then $I=\int\frac{d\phi}{1+\sin^2\varphi}=\int\frac{\cos\theta d\theta}{\sqrt{(1-2\sin^2\theta)}}$

$$=\frac{1}{\sqrt{2}}\sin^{-1}(\sqrt{2}\sin\theta)=\frac{1}{\sqrt{2}}\sin^{-1}\frac{\sqrt{2}\sin\theta}{\sqrt{(1+\sin^2\theta)}}.$$

Hence, $\left(I\right)_0^{\frac{1}{2}\pi}=\frac{1}{\sqrt{2}}\sin^{-1}1=\frac{\pi}{4}\sqrt{2}$.

III. Solution by CHRISTIAN HORNUNG, A. M., Heidelberg University, Tiffin, O., and GRACE M. BAREIS, Bala, Pa.

$$\int\frac{d\phi}{1+\sin^2\phi}=\int\frac{\sec^2\phi d\phi}{\sec^2\phi+\tan^2\phi}=\int\frac{\sec^2\phi d\phi}{1+2\tan^2\phi}.$$

If $\tan\phi=x$, $\int\frac{\sec^2\phi d\phi}{1+2\tan^2\phi}=\int\frac{dx}{1+2x^2}=\frac{1}{2}\int\frac{dx}{\frac{1}{2}+x^2}=\frac{1}{2}\frac{1}{\sqrt{\frac{1}{2}}}\tan^{-1}\frac{x}{\sqrt{\frac{1}{2}}}$

$=\frac{1}{2}\sqrt{2}\tan^{-1}x\sqrt{2}$, and, replacing the value of x, we have

$$\int_0^{\frac{1}{2}\pi}\frac{d\phi}{1+\sin^2\phi}=\left(\frac{1}{2}\sqrt{2}\tan^{-1}\sqrt{2}\tan\phi\right)_0^{\frac{1}{2}\pi}=\frac{\pi\sqrt{2}}{4}.$$

Also solved by John G. Kellar, F. D. Posey, J. E. Sanders, J. Scheffer, S. A. Corey, G. W. Greenwood, E. L. Sherwood, Homer R. Higley, and L. E. Newcomb.

MECHANICS.

168. Proposed by M. E. GRABER, A. B., Instructor in Mathematics and Physics in Heidelberg University, Tiffin, Ohio.

In Bifilar Suspension W is the weight of the suspended mass, a and b the distances between the threads above and below, h the vertical height of the threads. If the difference in vertical components of tension is n times W and θ is the angle turned through in azimuth, momental resistance is $\frac{1}{4}(1-n^2)W(ab/h)\sin\theta$. [Perry's *Engineering*.]